Electronic Version
Stylesheet Version v1.1.1

Claims

[c1] A sound quality adjusting device for causing an input sound signal to pass through a plurality of digital filters, controlling gains of output signals from the plurality of digital filters, summing sound signals having been subjected to gain control, and outputting a sum, the device comprises:

a first filter for multiplying a signal of each tap of a tapped delay line by several times according to given first filter factors and then performing addition and output, the delay line being made up of a plurality of delay units; and

a second filter for multiplying a signal of each tap of a tapped delay line by several times according to given second filter factors and then performing addition and output, the delay line being made up of a plurality of delay units;

wherein

the first filter factors have a symmetrical sequence in which values are set so that a sum is not zero and a sum of every other terms is equal to a sum of the other every other terms with the same signs; and

the second filter factors have a symmetrical sequence in

which values are set so that a sum is zero and a sum of every other terms is equal to a sum of the other every other terms with opposite signs.

[c2] The sound quality adjusting device according to claim 1, in the second filter factors, signs of values other than a median of the sequence of the first filter factors are changed while causing absolute values of the sequence to remain the same.

[c3] The sound quality adjusting device according to claim 1, in the second filter factors, signs of values other than a median of the sequence of the first filter factors are changed while causing absolute values of the sequence to remain the same, and the median of the sequence is subtracted from a reference value.

[c4] The sound quality adjusting device according to claim 1, the sequence of the first filter factors is composed of ratios of -1, 0, 9, 16, 9, 0, and -1 and the sequence of the second filter factors is composed of ratios of 1, 0, -9, 16, -9, 0, and 1.

[c5] The sound quality adjusting device according to claim 1, at least one of the first filter and the second filter is cascaded to a subsequent stage of at least one of the first filter and the second filter.

[c6] The sound quality adjusting device according to claim 1, the first filter and the second filter are cascaded in parallel to a subsequent stage of the first filter, the first filter and the second filter are cascaded in parallel to a subsequent stage of the second filter, control is performed on a gain of an output signal from each of the cascaded filters in the subsequent stage, and sound signals having been subjected to gain control are summed and outputted.

[c7] A filter device, comprising:
a first filter for multiplying a signal of each tap of a tapped delay line by several times according to given first filter factors and then performing addition and output, the delay line being made up of a plurality of delay units; and
a second filter for multiplying a signal of each tap of a tapped delay line by several times according to given second filter factors and then performing addition and output, the delay line being made up of a plurality of delay units;
wherein
the first filter factors have a symmetrical sequence in which values are set so that a sum is not zero and a sum of every other terms is equal to a sum of the other every other terms with the same signs; and

the second filter factors have a symmetrical sequence in which values are set so that a sum is zero and a sum of every other terms is equal to a sum of the other every other terms with opposite signs.

[c8] The filter device according to claim 7, in the second filter factors, signs of values other than a median of the sequence of the first filter factors are changed while causing absolute values of the sequence to remain the same.

[c9] The filter device according to claim 7, in the second filter factors, signs of values other than a median of the sequence of the first filter factors are changed while causing absolute values of the sequence to remain the same, and the median of the sequence is subtracted from a reference value.

[c10] The filter device according to claim 7, the sequence of the first filter factors is composed of ratios of -1, 0, 9, 16, 9, 0, and -1 and the sequence of the second filter factors is composed of ratios of 1, 0, -9, 16, -9, 0, and 1.

[c11] The filter device according to claim 7, at least one of the first filter and the second filter is cascaded to a subsequent stage of at least one of the first filter and the second filter.

[c12] A sound quality adjusting method, comprising:

a first filtering step of multiplying a signal of each tap of a tapped delay line, which delays an input sound signal, by several times by using first filter factors and then performing addition and output, the first filter factors having a symmetrical sequence in which values are set so that a sum is not zero and a sum of every other terms is equal to a sum of the other every other terms with the same signs;

a second filtering step of multiplying a signal of each tap of a tapped delay line, which delays an input sound signal, by several times by using second filter factors and then performing addition and output, the second filter factors having a symmetrical sequence in which values are set so that a sum is zero and a sum of every other terms is equal to a sum of the other every other terms with opposite signs;

a gain controlling step of controlling a gain of a sound signal having passed through the first filtering step and a gain of a sound signal having passed through the second filtering step; and

a summing step of summing the sound signals having undergone gain control in the gain controlling step and outputting a sum.

[c13] The sound quality adjusting method according to claim 12, the sequence of the first filter factors is composed of ratios of -1, 0, 9, 16, 9, 0, and -1 and the sequence of the second filter factors is composed of ratios of 1, 0, -9, 16, -9, 0, and 1.

[c14] A filter designing method for designing a plurality of digital filters in which frequency characteristics are complementary to each other and a total gain of the filters serves as a reference value at all frequencies,
based on first filter factors having a symmetrical sequence in which values are set so that a sum is not zero and a sum of every other terms is equal to a sum of the other every other terms with the same signs, the sequence of the first filter factors is changed, so that second filter factors having a symmetrical sequence are determined in which values are set so that a sum is zero and a sum of every other terms is equal to a sum of the other every other terms with opposite signs, and the first filter factors and the second filter factors are used as the filter factors of the plurality of digital filters.

[c15] A filter designing method for designing a plurality of digital filters in which frequency characteristics are complementary to each other and a total gain of the filters serves as a reference value at all frequencies,
based on second filter factors having a symmetrical se-

quence in which values are set so that a sum is zero and a sum of every other terms is equal to a sum of the other every other terms with opposite signs, the sequence of the second filter factors is changed, so that first filter factors having a symmetrical sequence are determined in which values are set so that a sum is not zero and a sum of every other terms is equal to a sum of the other every other terms with the same signs, and the first filter factors and the second filter factors are used as the filter factors of the plurality of digital filters.